AN INVESTIGATION INTO FACTORS INFLUENCING GRAPE WORKER SUSCEPTIBILITY TO SKIN RASHES

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SUMMARY

Field workers employed by a major grape grower were monitored daily during the 1982 growing season. A total of 1,043 workers performed 425,405 hours of work and sustained 25 skin rashes. Thinning operations accounted for 52 percent of the rashes although they represented only 13 percent of the total hours worked. Results suggest that temperature increases are associated with increases in the incidence of skin rashes; a statistically significant correlation was observed between temperature and the incidence of rashes during thinning. No individual grape variety accounted for a large percentage of the rash cases, but the rash incidence rates were higher for table grapes than for wine grapes. No apparent relationship existed between the use of pesticides and the incidence of rashes.

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Factors Influencing Grape Worker Susceptibility to Skin Rashes

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Skin disease has been shown to be the leading cause of occupational illness in California (California Department of Industrial Relations 1982). The majority of the skin disorders involve contact dermatitis and are generally mild in nature. Personal suffering and decreased production often result from these conditions.

It is well known that cases of dermatitis involving field workers employed in California vineyards are common events. Although the occurrence of dermatitis from pesticide exposure is regarded as rare (Fregert and Hjorth 1972, Matsushita et al. 1980), the presence of pesticides in vineyards has long been suspected as a cause for skin rashes. This postulate is supported by the common use of two known skin irritants, sulfur and propargite, on grapes during the growing season. As a result, the California Department of Food and Agriculture (CDFA) has adopted worker reentry intervals for these two chemicals (California Department of Food and Agriculture 1982). Even with these regulations, skin rashes still occur regularly in grape worker populations.

Several additional factors have been proposed as causes for the dermatoses, including a variety of physical, chemical, and biological agents. Workers exposed to high temperatures often experience "heat rash" resulting from alterations in sweat delivery (Sulzberger and Hermann 1954, Lobitz and Dobson 1965, Cohen 1982). Exposure to naturally occurring chemicals found on plants has also been shown to cause dermatitis (Cookson 1953, Klauder and Kimmish 1956, Birmingham et al. 1961, Sinha et al. 1977). In addition, nonoccupational dermatoses from a variety of household products, such as perfumes, shampoos, cosmetics, and soaps (Hjorth and Fregert 1972) and to environmental agents, including dusts, pollens, and vegetables (Klauder and Kimmish 1956, Sinha et al. 1977), have also been reported in the literature.

The Worker Health and Safety Unit of CDFA initiated a study in 1982 designed to examine several suspected factors which may contribute to the occurrence of skin rashes in the vineyards.

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MATERIALS AND METHODS

Cooperation of one of California's major grape growers from the Central Valley was obtained for this study. Daily records for 1,043 field workers were obtained during the growing season of mid-February until late October 1982.

The grower's field accounting office furnished daily records of each employed crew. Included on the crew sheets were the total number of workers in the crew, total hours worked, job activity, and the variety and location of the vineyard on which work was performed. In a few instances, information on the crew sheets was incomplete or illegible; the data on these crew sheets were not used in the study.

Daily temperature information was obtained from weather summaries prepared by the grower.

Pest Control Operator Recommendations provided information regarding the date and location of pesticide applications.

Records of workers sustaining rashes were obtained from the firm's nurse, who examined, treated, and scheduled medical appointments for affected workers. This information was used to trace other records to determine the job activity of the worker, the daily temperature, and the grape variety, location, and pesticide application history of the vineyard associated with the rash occurrence.

Data was compiled with the help of a computer. Following data input, incidence rates of dermatitis were expressed for individual job activities, grape varieties, and temperature conditions.

RESULTS AND DISCUSSION

Of the 1,043 vineyard workers monitored, 25 sustained rashes, corresponding to a rate of 24 rashes per 1,000 workers over a period of 294 days. A total of 425,405 work hours were recorded.

The chemical application histories of the vineyards in which rashes occurred are summarized in Table 1. In 10 of the 25 rash cases, Bacillus Thuringiensis applications were made to vineyards within 14 days of rash occurrence. No other chemical was found to have been applied to the vineyards within 14 days of rash occurrence on more than five occasions. In nine rash cases (36 percent), no chemicals were known to have been applied within the 14 day period.

The rash incidence for individual job activities are included in Table 2. Although thinning accounted for only 12.9 percent of the total hours worked, 13 of the 25 rash cases (52 percent)

involved thinning. Harvesting, with seven rashes, was the only other job activity to account for more than two rash cases.

Table 3 lists the incidence rates of skin rashes as a function of temperature. Data in this table suggest that temperature increases are associated with increases in the incidence of worker rashes.

The rash incidence by individual grape variety is shown in Table 4. Work in table grape vineyards represented 80 percent of the total work hours and 96 percent of the rash cases.

The large incidence rate seen in Table 2 for workers involved in thinning operations suggested that this activity be further investigated. In Table 5, a strong relationship between the incidence of rashes occurring during thinning and temperature is shown. The average high temperature on days that the rashes occurred was 91.7 degrees, while the average on days in which thinning was performed in the absence of rashes was 87.0 degrees. A t-test revealed a significant difference between the two averages at the $p = 0.05$ level.

Of the 13 rashes which occurred during thinning, nine (69 percent) occurred in the Flame Seedless or Thompson Seedless varieties. These were the only varieties to which the plant growth regulator, gibberellic acid, had been added. In each of these cases, gibberellic acid applications had been made within 14 days of the rashes. Further investigation revealed that thinning operations in these two varieties accounted for 45 percent of the total thinning hours. As a result, a correlation between the use of gibberellic acid and the occurrence of skin rashes is not clearly demonstrated.

Propargite, a known skin irritant, is often applied to grapes as an acaricide. During this study, applications of propargite within 14 days of the development of skin rashes were noted in only two of the rash cases involving thinning.

The identification of causal factors of dermatitis among agricultural workers is a very difficult task (Hjorth and Fregert 1972, Bettley 1965, Hearn 1973). Agricultural workers are exposed to a number of agents which have been associated with skin irritation in humans such as high temperature, fertilizers, oils, rubber materials, plants, and pesticides. Both occupational and nonoccupational factors must be considered.

For the purposes of this study, any observable rash condition was reported by the company nurse as a "rash" case. Although records for many workers were incomplete, communication with the nurse revealed that the majority of the rashes occurred on areas of the body protected by clothing rather than on exposed surfaces such as the face, neck, and hands. Rashes were

Table 1. Chemicals Applied to Vineyards Within 14 Days of Rash Occurrences

Chemical	Number of Applications 1-3 Days Before Rash	4-7 Days Before Rash	8-14 Days Before Rash	Total
PESTICIDES				
Bacillus Thuringiensis	0	4	6	10
Bayleton	0	2	3	5
Nudrin	0	2	3	5
Cymate	0	2	1	3
Paraquat	0	0	3	3
Propargite	0	0	3	3
Cygon	0	0	3	3
Princep	1	0	0	1
Roundup	1	0	0	1
Captan/Botran/Sulfur	0	1	0	1
OTHER CHEMICALS				
Triton (Spray Adjuvant)	3	5	1	9
Gibberellic Acid	0	5	4	9
Spreader (Spray Adjuvant)	1	0	3	4
ZNP (Foliar Nutrient	0	1	3	4
Nutriphos (Foliar Nutrient)	3	0	0	3
Nutrizinc (Foliar Nutrient	3	0	0	3

TOTAL RASH CASES: 25

generally mild, did not result in time loss from work, dissipated fairly rapidly, and were rarely prone to reoccurrence.

Criteria for proper diagnosis of occupational skin disorders have often been published (Bettley 1965, Key 1967, Gellin 1972). Unfortunately, these procedures involve rather lengthy testing periods which are generally unacceptable to workers and employers.

Rashes diagnosed as being "pesticide-related" frequently lack verification and are often based on occupational exposure potential alone. Under Section 2950 of the California Health and Safety Code, any physician who suspects an illness or injury has been caused by a pesticide is required to report it within 24 hours to the local health officer, who subsequently reports it to the county agricultural commissioner. Physicians failing to report such cases are subject to fines. Reported incidents

Table 2. Incidence Rates of Skin Rashes by Job Activity

Job Activity	Total Hours Worked	Rashes	Incidence Rate (Rashes/Work Hours) $x10^5$
Thinning	54,783	13	23.7
Chemical Weeding	6,089	1	16.4
Leafing-Cane Turning	16,250	2	12.3
Tying	8,463	1	11.8
Stump Suckering	14,590	1	6.9
Harvesting	250,408	7	2.8
Training	49,794	0	0.0
Side Lateraling	6,584	0	0.0
Water Distribution System Maintenance	5,283	0	0.0
Hand Weeding	4,569	0	0.0
Crown Suckering	3,853	0	0.0
Trellis-Wire-Stakes and Tree Props	2,035	0	0.0
Pruning-Brush Disposal	1,146	0	0.0
Fertilizing	518	0	0.0
Irrigating	454	0	0.0
Tree-Vine Replacement	294	0	0.0
Cane Trimming	180	0	0.0
Cover Cropping	112	0	0.0
TOTAL	405,405	25	5.9

Table 3. Incidence Rates of Skin Rashes by Temperature

Temperature High (Range)	Total Hours Worked	Rashes	Incidence Rate (Rashes/Work Hours) $x10^5$
79 and below	69,817	3	4.3
80-89	156,591	6	3.8
90-99	160,521	11	6.9
100 and above	38,476	5	13.0
TOTAL	425,405	25	5.9

are investigated by the county agricultural commissioner's staffs and are reviewed and classified by members of the Worker Health and Safety Unit of CDFA. In 1982, 176 incidents of skin rashes among grape workers were suspected of being "pesticide-related." Of these only two were definitely linked with pesticide exposure, 24 were classified as "probably" pesticide-related, 83 were listed as "possibly" pesticide-related, and pesticide causes were determined to be unlikely in 30 cases. In the remaining 37 cases, classification was not possible due to inadequate information received from physicians and/or county investigations.

Table 4. Incidence Rates of Skin Rashes by Grape Variety

Variety	Total Hours Worked	Rashes	Incidence Rate (Rashes/Work Hours)x10^5
TABLE GRAPES			
Flame Seedless	6,998	4	57.2
Cardinal	10,168	2	19.7
Black Seedless	13,935	2	14.4
Emperor	38,286	4	10.4
Thompson Seedless	102,695	5	4.9
Other Seedless	128,117	6	4.7
Ribier	33,327	1	3.0
Calmeria	8,894	0	0.0
Total-Table Grapes	342,420	24	7.0
WINE GRAPES			
Ruby Cabernet	6,272	1	15.9
French Columbard	45,478	0	0.0
Grenache	8,029	0	0.0
Chenin Blanc	5,502	0	0.0
Muscatel Canelli	4,579	0	0.0
Muscatel Alexandra	3,653	0	0.0
Ribired	2,485	0	0.0
Emerald Riesling	2,053	0	0.0
Carignane	1,683	0	0.0
Pedro Ximines	1,612	0	0.0
Semillon	923	0	0.0
Barbera	716	0	0.0
Total-Wine Grapes	82,985	1	1.2
TOTAL-ALL GRAPES	425,405	25	5.9

Table 5. Incidence Rates of Thinning Rashes by Temperature

Temperature High (Range)	Total Hours Worked	Rashes	Incidence Rate (Rashes/Work Hours) x10^5
79 and below	5,577	0	0.0
80-89	21,141	2	9.5
90-99	21,258	6	28.2
100 and above	6,807	5	73.5
TOTAL	54,783	13	23.7

In the majority of the grape worker rashes, sulfur and propargite were suspected by the physicians to be the causal agents. In this study, however, pesticides, in general, and propargite, in particular, did not appear to be major causitive factors of skin rashes (Table 1). An assessment of the ability of sulfur to cause skin rashes is not possible in the present

study since Bayleton, an experimentally registered fungicide, was used as a sulfur replacement for many applications. Bayleton has not been associated with skin irritation to date.

The potential for pesticides to cause rashes in field workers cannot be denied. Since 1977, five separate outbreakes of grape field worker rashes, involving 6, 8, 12, 13, and 56 workers, respectively, have been determined by CDFA to have resulted from propargite and/or sulfur exposure. In this study, only one multiple rash incident, involving three workers from a crew of 30, was reported. No sulfur or propargite applications had been made to this vineyard at the time of rash occurrence.

Perhaps a more important factor to be considered as a cause of the rashes is the effect of temperature. The incidence rate of skin rashes appears to increase as the temperature increases (Table 3). Marked temperature-dependent increases in rash incidence rates are apparent for workers in thinning operations (Table 5). This activity, which results in a large amount of foliage contact, was the job responsible for the highest rate of rashes (Table 2).

A variety of explanations for the increase in rash incidence as the temperature increases exist. Temperature increases may lead to increased sweating and pore opening, which may enhance penetration of dusts, pesticide chemicals, and foliage material through the skin. In addition, the sweat may serve as a trapping medium for these agents, concentrating them on the skin surface.

Temperature increases might also lead to increased production of irritants or photosensitizing agents by the vines or by invading microorganisms. Large outbreaks of dermatitis of microbial origin have been reported to occur in celery workers (Birmingham et al. 1961).

Additionally, rashes may be due to "heat rash" or miliaria. This condition results when the free flow of eccrine sweat to the surface is impeded, causing sweat retention in the skin (Sulzberger and Hermann 1954, Lobitz and Dobson 1965). Miliaria rubra occurs when sweat is retained in the epidermis, producing a rash in the affected area. Most rashes produced by miliaria rubra occur in areas which are covered by clothing. This is consistent with the location of most of the rashes developed by workers involved in thinning.

From the results in Table 4, it does not appear that any specific grape variety is responsible for a large percentage of the rash cases. The majority of the rashes occurred in the labor-intensive table grape varieties. These varieties were also responsible for the largest amount of work hours.

Occupational skin diseases were reported to affect 2.1 per 1,000

workers in California in 1977 (California Department of Industrial Relations 1982). The rate for agricultural workers was 8.6 cases per 1,000 workers. During this study, 24.0 rash cases per 1,000 workers were observed. This finding, coupled with poor correlation between pesticide use and rash incidence, suggests that non-pesticide causes may be responsible for the large numbers of skin rashes experienced by California's grape workers.

The difficulty in establishing causal factors of occupational illness has been discussed. It must be remembered that the results of this study have been obtained from only one grower and that other growers may utilize different employment and agricultural practices which could influence the incidence of rashes. Results from this, study, therefore, while suggestive of possible causal factors for skin rashes in grape workers, cannot be considered conclusive. Additional studies, including the screening of grape foliage material for potential irritants and photosensitizers, coupled with more comprehensive medical diagnoses, are necessary.

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